

What is claimed is:

1. A microcatheter system for infusion of a solution into a retinal vein, wherein the microcatheter system remains within the retinal vein during the infusion without an external holding device for at least a period of time
5 required for a bolus injection.

2. A microcatheter system comprising:
a flexible cannula for insertion into a retinal vein lumen, whereby a solution is infused into the retinal vein lumen through the flexible cannula
10 and the flexible cannula remains within the retinal vein lumen during the infusion without an external holding for at least a period of time required for a bolus injection.

3. A microcatheter system comprising:
15 a flexible cannula for insertion into a retinal vein lumen, whereby a solution is infused into the retinal vein lumen through the flexible cannula and the flexible cannula remains within the retinal vein lumen during the infusion without an external holding device.

20 4. The microcatheter system of any one of claims 1 through 3, wherein solution is infused at a flow rate of at least about 0.2 cc/min.

5. The microcatheter system of any one of claims 1 through 4, wherein the microcatheter system comprises a flexible cannula for insertion into a retinal vein lumen, the flexible cannula having a proximal end and a distal end and the distal end is sharp and rigid for puncturing the retinal vein
25 lumen.

6. The microcatheter system of any one of claims 1 through 5, wherein
30 the distal end has a beveled ramp-like shape.

7. The microcatheter system of any one of claims 1 through 6, wherein the ramp-like distal end forms an angle of about 30°.

8. The microcatheter system of any one of claims 1 through 7, wherein the flexible cannula is fabricated of polyimide.

9. The microcatheter system of any one of claims 1 through 8, wherein the flexible cannula has an outer diameter less than about 100 μm .

10. The microcatheter system of claim 9, wherein the flexible cannula has an outer diameter of from about 50 μm to about 80 μm .

11. The microcatheter system of claim 10, wherein the flexible cannula has an outer diameter of about 66 μm .

12. The microcatheter system of any one of claims 1 through 11, further comprising a second cannula having a larger diameter than the flexible cannula.

13. The microcatheter system of claim 12, wherein the second cannula is less flexible than the flexible cannula.

14. The microcatheter system of claim 12, wherein second cannula has a proximal end and a distal end, and a portion of the flexible cannula is housed within the distal end of the second cannula.

15. The microcatheter system of claim 14, wherein the second cannula forms a fluid-tight seal about the flexible cannula.

16. The microcatheter system of claim 12, wherein the proximal end of the second cannula is sized for attachment to the tip of a syringe through which solution is infused.

17. The microcatheter system of claim 12, wherein the second cannula has an outer diameter that ranges from about 400 μm to about 800 μm .

18. The microcatheter system of claim 17, wherein the second cannula has an outer diameter of about 556 μm .

5 19. The microcatheter system of any one of claims 1 through 18, further comprising a modified microcannula system in which the flexible cannula and second cannula are mounted.

10 20. The microcatheter system of claim 19, wherein the modified microcannula system further includes an inner plug mounted on the modified microcannula system.

21. The microcatheter system of claim 20, wherein the inner plug is fabricated of silicone.

15 22. The microcatheter system of claim 20, wherein the inner plug has an aperture through which the second cannula and flexible cannula are inserted.

20 23. The microcatheter system of claim 20, wherein the inner plug forms a fluid-tight seal about the second cannula.

24. The microcatheter system of any one of claims 1 through 23, wherein the flexible cannula is illuminated for enhanced visibility.

25 25. The microcatheter system of any one of claims 1 through 24, wherein the microcatheter system or flexible cannula remains within the retinal vein during the infusion without an external holding device for a period of time of at least 5 minutes.

30 26. The microcatheter system of claim 25, wherein the period of time is at least 10 minutes.

27. The microcatheter system of claim 26, wherein the period of time is at least 20 minutes.

28. The microcatheter system of claim 27, wherein the period of time is at least 30 minutes.

29. The microcatheter system of claim 28, wherein the period of time is at least 40 minutes.

30. The microcatheter system of claim 29, wherein the period of time is at least 50 minutes.

31. The microcatheter system of claim 30, wherein the period of time is at least one hour.

32. The microcatheter system of claim 31, wherein the period of time is at least one and a half hours.

33. The microcatheter system of claim 32, wherein the period of time is at least two hours.

34. A medical device kit, comprising one or more of the microcatheter systems of any one of claims 1 through 33.

35. The kit of claim 34 wherein the one or more microcatheter systems are packaged in sterile condition

36. A method for manual retinal vein catheterization, the method comprising the steps of:

providing a microcatheter system comprising: a flexible cannula for insertion into a retinal vein, the flexible cannula having a proximal end and a distal end, and the distal end being sharp and rigid for puncturing the retinal vein;

inserting the microcatheter system into the eye through an incision; positioning the microcatheter system so that the distal end of the flexible cannula is approximately parallel to the retinal vein;

puncturing the retinal vein with the distal end of the flexible cannula and inserting the flexible cannula into the retinal vein;

releasing the microcatheter system;

infusing a solution into the retinal vein through the flexible cannula,

5 whereby the solution is infused through the flexible cannula and the flexible cannula remains within the retinal vein during the infusion without an external holding device, for at least a period of time required for a bolus injection; and

10 removing the cannula and microcatheter system from the retinal vein and from the eye.

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39. A method for manual retinal vein catheterization comprising using the microcatheter system of any one of claims 1 through 3 by inserting the microcatheter system or cannula within a retinal vein in an eye and infusing
15 solution into the retinal vein, whereby the microcatheter system or cannula remains within the retinal vein without an external holding device.

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20 40. The method of claims 38, or 39, wherein solution is infused at a flow rate of at least about 0.2 cc/min.

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25 41. The method of any one of claims 38 through 40, further comprising inserting a metal cannula into an incision in the eye prior to inserting the microcatheter system into the eye, whereby the microcatheter system is inserted into the eye through the metal cannula.

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42. The method of claim 41, further comprising insertion of a microcannula through the metal cannula, wherein the microcatheter system is inserted into the eye through the metal cannula.

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43. The method of any one of claims 36 through 42, further comprising the step of making four sclerotomies in the eye, whereby two microforceps are inserted in two of the sclerotomies and the microcatheter system is inserted into the eye through the fourth sclerotomy.

42 44. The method of claim 43, wherein the fourth sclerotomy site is made such that the microcatheter system is inserted into the eye with the flexible cannula approximately parallel to the retinal vein.

5 45. The method of claims 43 or 44, further comprising the step of using the microforceps to direct the flexible cannula towards the optic disc of the eye.

10 46. The method of any one of claims 43 through 45, further comprising the steps of passing the microcatheter system back and forth between the microforceps to position the microcatheter system so that the distal end of the flexible cannula is approximately parallel to the retinal vein

15 47. The method of any one of claims 36 through 46, wherein the microcatheter system further comprises a second cannula having a larger diameter than the flexible cannula, the second cannula having a proximal end and a distal end, whereby a portion of the flexible cannula is housed within the distal end of the second cannula.

20 48. The method of claim 47, wherein the proximal end of the second cannula is attached to the tip of a syringe through which solution is infused, and the second cannula forms a fluid-tight seal about the flexible cannula.

25 49. The method of any one of claims 36 through 48, wherein the microcatheter system or flexible cannula remains within the retinal vein during the infusion without an external holding device for a period of time of at least 5 minutes.

30 50. The method of claim 49, wherein the period of time is at least 10 minutes.

49 51. The method of claim 50, wherein the period of time is at least 20 minutes.

52. The method of claim 51, wherein the period of time is at least 30 minutes.

53. The method of claim 52, wherein the period of time is at least 40
5 minutes.

54. The method of claim 53, wherein the period of time is at least 50 minutes.

10 55. The method of claim 54, wherein the period of time is at least one hour.

56. The method of claim 55, wherein the period of time is at least one and a half hours.

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58 57. The method of claim 56, wherein the period of time is at least two hours.

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